Board of Education Agenda Item

Item: G. **Date:** February 17, 2011

Topic: First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Cut Score for the Praxis Technology Education Assessment

Presenter: Mrs. Patty S. Pitts, Assistant Superintendent for Teacher Education and Licensure

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Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- _X_ Board of Education regulation
- ____ Other: _____

___ Action requested at this meeting _X_ Action requested at future meeting: March 24, 2011

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:

The responsibility for teacher licensure is set forth in section 22.1-298.1 of the *Code of Virginia,* which states that the Board of Education shall prescribe by regulation the requirements for licensure of teachers. The *Licensure Regulations for School Personnel (September 21, 2007)* 8VAC20-22-40 (A) state, in part, that "…all candidates who hold at least a baccalaureate degree from a regionally accredited college or university and who seek an initial Virginia teaching license must obtain passing scores on professional teacher's assessments prescribed by the Board of Education."

The Board of Education prescribes the Praxis II (subject area content) examinations as the professional teacher's assessment requirements for initial licensure in Virginia. The Board originally approved cut scores on 16 subject content tests that became effective July 1, 1999. Subsequently, the Board adopted additional content knowledge tests as they were developed by the Educational Testing Service (ETS). Virginia teachers and teacher educators participated in validation and standard setting studies guided by ETS personnel to ensure an appropriate match between Praxis II tests and the competencies set forth in Virginia's regulations, as well as the K-12 *Standards of Learning*.

ETS continues to update the Praxis II assessments through the test regeneration process. When this process results in substantial changes to the assessment, another standard setting study is required.

Summary of Major Elements

To support the decision-making process for the Virginia Department of Education with regards to establishing a passing score, or cut score, for the Praxis Technology Education Assessment (0051), research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on November 16, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The study involved an expert panel comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers, and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The panel was convened on November 16, 2010, in Richmond, Virginia. The technical report (Appendix A) is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

In addition, research staff from the Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies in October 2010. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers. The attached technical report (Appendix B) details the work of the multi-state committees.

The Praxis Technology Education *Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two-hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction Technologies* (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions). Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate's score. (Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate's score.) The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education Assessment (0051) ranges from 100 to 200 scaled-score points.

The process used in the Virginia standard setting study is detailed in Appendix A. The panel's cut score recommendation for the Praxis Technology Education Assessment (0051) is 74.96 (see Table 1). The value was rounded to 75, the next highest whole number, to determine the functional recommended cut. The value of 75 represents approximately 68 percent of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 75 raw points is 162.

A similar process was used in the multi-state standard setting studies as described in Appendix B. The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score (see

Table 2). For the Praxis Technology Education Assessment (0051), the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66 percent of the total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

When reviewing the Standard Error of Measurement (SEM) for the cut scores recommended by the Virginia Standard Setting Study as well as the Multi-State Studies, there is an overlap in the scaled scores. The SEM is a statistical phenomenon and is unrelated to the accuracy of scoring. All test results are subject to the standard error of measurement. If a test-taker were to take the same test repeatedly, with no change in his level of knowledge and preparation, it is possible that some of the resulting scores would be slightly higher or slightly lower than the score that precisely reflects the test-taker's actual level of knowledge and ability. The difference between a test-taker's actual score and his highest or lowest hypothetical score is known as the standard error of measurement. The Standard Error of Measurement for the recommended cut scores for the Virginia Standard Setting Study and the Multi-State Studies are shown on the next page. Note that consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Standard Error of Measure Summaries – Technology Education (0051)

Table 1

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Technology Education – Virginia

Recommended Cut Score (SEM)		Scale Score Equivalent
	75 (4.91)	162
-2 SEMs	66	150
-1 SEM	71	156
+1 SEM	80	168
+2 SEMs	85	175

Table 2

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Technology Education – Multi-State Studies

Panel 1:

Recommended Cut Score (SEM)		Scale Score Equivalent
	72 (5.01)	158
-2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+2 SEMs	83	172

Panel 2:

Recommended Cut Score (SEM)		Scale Score Equivalent
	74 (4.94)	160
-2 SEMs	65	149
-1 SEM	70	155
+1 SEM	79	167
+2 SEMs	84	173

Combined Across Panels:

Recommended Cut Score (SEM)		Scale Score Equivalent
	73 (4.98)	159
-2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+2 SEMs	83	172

Note: Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

On January 24, 2011, the Advisory Board for Teacher Education and Licensure (ABTEL) recommended that the Board of Education set a cut score of 162 for the Praxis Technology Education Assessment (0051) for individuals seeking an initial license with an endorsement in Technology Education. The revised assessment will be offered after September 1, 2011.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education receive for first review the Advisory Board on Teacher Education and Licensure's recommendation to set a cut score of 162 for the Praxis Technology Education Assessment (0051) for individuals seeking an initial Virginia license with an endorsement in Technology Education.

Impact on Resources:

Costs associated with the administration of the Praxis Technology Education Assessment (0051) will be incurred by the Educational Testing Service. Prospective teachers seeking an initial Virginia license with an endorsement in Technology Education will be required to pay the registration and test fees.

Timetable for Further Review/Action:

This item will be presented to the Board of Education for final review on March 24, 2011.

Listening. Learning. Leading.

Standard Setting Technical Report

PRAXIS TECHNOLOGY EDUCATION (0051)

Prepared for the Virginia Department of Education

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

November 2010

Executive Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on November 16, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

Recommended Cut Scores

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score is 75 (on the raw score metric), which represents 68% of total available 110 raw score points. The scaled score associated with a raw score of 75 is 162.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The study involved an expert panel, comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The panel was convened on November 16, 2010, in Richmond, Virginia. The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

The passing score recommendation for the Praxis Technology Education (0051) assessment is provided to the VDOE. The VDOE is responsible for establishing the final passing score in accordance with applicable state regulations. The study provides a recommended passing score, which represents the combined judgments of one group of experienced educators. The full range of the VDOE's needs and expectations could not be represented during the standard setting study. The VDOE, therefore, may want to consider both the panel's recommended cut score and other sources to information when setting the final Praxis Technology Education (0051) cut score (Geisinger & McCormick, 2010). Other kinds of information may provide reasons for the VDOE to adjust the recommended cut score. The recommended cut score may be accepted, adjusted upward to reflect more stringent expectations, or adjusted downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two critical sources of information to consider when setting the cut score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of Praxis Technology Education (0051) scores and the latter the reliability of panelists' cut score recommendations. The SEM allows the VDOE to recognize that a Praxis Technology Education (0051) score—any test score on any test—is less than perfectly reliable. A test score only approximates what a

candidate *truly* knows or *truly* can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to consider the likelihood that the recommended cut score from the current panel would be similar to cut scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a cut score consistent with the recommended cut score. The larger the SEJ, the less likely the recommended cut score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification error. That is, when adjusting a cut score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual knowledge/skill level is lower (i.e., the candidate does not possess the required knowledge/skills). A false negative occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error to minimize; it is not possible to eliminate both types of decision errors simultaneously.

Overview of the Praxis Assessment

The *Praxis Technology Education Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction*

Technologies (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions)[1].

Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate's score[2]. The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education (0051) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

The following section describes the processes and methods used to train panelists, gather panelists' judgments and to calculate recommended passing scores, or cut scores. (The agenda for the panel meeting is presented in the Appendix.)

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by James Lanham, from the VDOE. The ETS facilitator then explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

Reviewing the Assessment

The first activity was for the panelists to "take the test." (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the multiple-choice questions. The purpose of "taking the test" was for the panelists to become familiar with the test format, content, and difficulty. After "taking the test," the panelists were given the answer key for the assessment and checked their responses. How well the panelists did on the assessment was not shared with the panel.

[1] The number of questions for each content area may vary slightly from form to form of the assessment.
[2] Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate's score.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering technology education teachers, and areas that addressed content that would be particularly important for entering teachers.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified technology education teacher. The JQC definition is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

The panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to *Praxis Technology Education Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a final definition (see the consensus JQC definition in the Appendix).

Panelists' Judgments

The standard-setting process for the Praxis Technology Education (0051) assessment was conducted for the overall test. A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each multiple-choice question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on the first five questions.

Judgment of Content Specifications

In addition to the standard setting process, the panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level technology education teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — V*ery Important*, I*mportant*, S*lightly Important*, and N*ot Important*. Each panelist independently judged the six knowledge categories and 73 knowledge/skills statements.

Results

Expert Panels

The standard setting study included an expert panel. The VDOE recruited panelists to represent a range of professional perspectives. A description of the panel is presented below. (See Appendix for a listing of panelists.)

The panel included 15 teachers, administrators, and college faculty who prepare technology education teachers. In brief, 12 panelists were teachers, one was an administrator, and two were college faculty. Both of the panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Twelve panelists were White, two were African American, and one was Hispanic. Ten panelists were male. Thirteen panelists reported being certified technology education teachers in Virginia. The majority of panelists (11 of the 15 panelists or 73%) had

11 or fewer years of experience as a technology education teacher, and approximately a fifth had 16 or more years of teaching experience.

A fuller demographic description for the members of the panel is presented in Table 1.

Table 1

Panel Member Demographics

	N	Percent
Current Position		
Teachers	12	80%
Administrator/Department Head	1	7%
College Faculty	2	13%
Race		
White	12	80%
Black or African American	2	13%
Hispanic or Latino	1	7%
Gender		
Female	5	33%
Male	10	67%
Are you currently certified as a technology education teacher in Virginia?		
Yes	13	87%
No	2	13%
Are you currently teaching technology education in Virginia?		
Yes	12	80%
No	3	20%
Are you currently supervising or mentoring other technology education teachers?		
Yes	6	40%
No	9	60%

Table 1 (continued)

Panel Member Demographics

	N	Percent
How many years of experience do you have teaching technology education?		
3 years or less	1	7%
4 - 7 years	3	20%
8 - 11 years	7	47%
12 - 15 years	1	7%
16 years or more	3	20%
At what K-12 grade level are you currently teaching technology education?		
Middle School (6 - 8 or 7 - 9)	4	27%
High School (9 - 12 or 10 - 12)	7	47%
Not currently teaching at the K-12 level	4	27%
Which best describes the location of your K-12 school?		
Urban	2	13%
Suburban	5	33%
Rural	6	40%
Not currently teaching at the K-12 level	2	13%
If you are college faculty, are you currently involved in the training/preparation of technology education teachers?		
Yes	2	13%
No	0	0%
Not college faculty	13	87%

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. All panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments

A summary of the standard-setting judgments is presented in Table 2. The numbers in the table reflect the recommended cut scores — the number of raw points needed to "pass" the assessment — of each panelist. The panel's average recommended cut score and highest and lowest cut scores are

reported, as are the standard deviations (SD) of panelists' cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panel to recommend the same cut score on the same form of the assessment. A comparable panel's cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

The panel's cut score recommendation for the Praxis Technology Education (0051) assessment is 74.96 (see Table 2). The value was rounded to 75, the next highest whole number, to determine the functional recommended cut. The value of 75 represents approximately 68% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 75 raw points is 162.

Table 2

Summary of Standard Setting Judgments

Panelist	Cut Score
1	79.60
2	55.20
3	67.85
4	75.35
5	66.65
6	72.65
7	83.55
8	73.90
9	69.70
10	98.85
11	77.05
12	68.40
13	80.30
14	73.55
15	81.85
Average	74.96
SD	9.77
SEJ	2.52
Highest	98.85
Lowest	55.20

Table 3 presents the estimated standard errors of measurement (SEM) around the recommended cut score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard errors provided are an estimate, given that the Praxis Technology Education (0051) assessment has not yet been administered.

Table 3

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score

Recommended Cut Score (SEM)		Scale Score Equivalent
75 (4.91)		162
- 2 SEMs	66	150
-1 SEM	71	156
+1 SEM	80	168
+ 2 SEMs	85	175

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Technology Education (0051) assessment content specifications were important for entry-level technology education teachers. Panelists rated the six knowledge categories and 73 knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Table 4 (in Appendix).

The six knowledge categories were judged to be *Very Important* or *Important* by 87% or more of the panelists. The knowledge categories of *Pedagogical and Professional Studies* (73% of the panelists judged as *Very Important*) and *Technological Design and Problem Solving* (87% of the panelists judged as *Very Important*) were seen as the most important for beginning technology education teachers. The knowledge categories of *Information and Communication Technologies* (27% of the panelists judged as *Very Important* and 13% of the panelists judged as *Slightly Important*) and *Manufacturing and Construction Technologies* (27% of the panelists judged as *Very Important* and 7% of the panelists judged as *Slightly Important*) were seen as less important for beginning technology education teachers. All but 5 of the 73 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations.

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation. Table 5 (in Appendix) present the results of the final evaluations.

All panelists *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Approximately 73% of the panelists *strongly agreed* that the standard-setting process was easy to follow.

Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing score, or cut score, for Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For Praxis Technology Education (0051), the average recommended cut score is 75 (on the raw score metric), which represents 68% of total available 110 raw score points. The scaled score associated with a raw score of 75 is 162.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

References

Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.

ETS. (In press). *Technology Education Test at a Glance*. Princeton, NJ.

Geisinger, K.F., & McCormick, C.A. (2010). Adopting cut scores: Post-standard-setting panel considerations for decision makers. *Educational Measurement: Issues and Practice, 29*, 38–44.

Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.

Appendix

Praxis Names and Affiliation

Panelist	Affiliation
Christopher Balthis	Wise County Public School
Laura Cooper	Bath County Public Schools
Nanette M. Dean	Norfolk City Public Schools
James T. DeMarino	Arlington County Public Schools
Todd D. Fantz	Old Dominion University
Sarah Gerrol	Roanoke County Public School
Jim Hawley	Campbell County Public School
Cecilia B. Hess	Virginia Beach City Public Schools
Deidrai D. Murray	Norfolk City Public Schools
Kevin L. O'Rear	New Kent County Public Schools
Michael Piccione	Prince William County Public Schools
Philip A. Reed	Old Dominion University
John Ruf	Spotsylvania County Public Schools
Scott C. Settar	Fairfax County Public Schools
Mathew B. Weatherford	Pittsylvania County Public Schools

Agenda: TECHNOLOGY EDUCATION (6-12) PANEL

Tuesday, November 16, 2010

8:00 am	**Registration and Breakfast**
8:30 am	**Welcome and Introduction**
8:50 am	**Overview of Study**
9:20 am	**Take the Test and Self-Score**
10:50 am	**BREAK**
11:00 am	**Discuss the Test Content**
11:30 am	**Discuss the Just Qualified Candidate (JQC)**
Noon	**LUNCH**
12:45 pm	**Define the Just Qualified Candidate (JQC) - Continued**
1:30 pm	**Training for Standard Setting Judgments**
2:00 pm	**Complete Standard Setting Judgments**
	BREAK
3:00 pm	**Specification Judgment Training**
3:30 pm	**Complete Specification Judgments**
3:45 pm	**Complete Final Evaluation**
4:00 pm	**Collect Materials and Adjourn**

Thank You for Participating

Description of a Just Qualified Candidate

Praxis Technology Education (0051)

(Developed for the Virginia Department of Education)

- Understands the importance of collaboration and interdisciplinary teaching and demonstrates the relationships in context between technology and other curricular areas
- Can identify and model key safety concerns and practices
- Can describe and apply technological design and problem solving processes
- Can identify and implement objectives that address specific state competencies and national standards
- Uses major concepts, terminology and appropriate tools related to the teaching of technological core topics, i.e., power, energy, transportation, manufacturing, communication, information technology, construction
- Understands and applies the systems model
- Understands and utilizes a variety of professional development opportunities, i.e., professional associations and student organizations
- Can evaluate a technology's impact and identify its interrelationships with society
- Utilizes multiple instructional strategies and assessments that facilitate student achievement and technological literacy

Table 4

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
I.	**Technology and Society**	**10**	**67%**	**5**	**33%**	**0**	**0%**	**0**	**0%**
	• Understands the nature of technology, technology education, and technological literacy.	15	100%	0	0%	0	0%	0	0%
	• Understands how invention and innovation occur, how they are influenced by cultural and economic factors, and how they are built on existing technologies.	6	40%	8	53%	1	7%	0	0%
	• Understands how technological development is influenced by knowledge from other fields of study, especially mathematics and the sciences.	7	47%	8	53%	0	0%	0	0%
	• Understands the influence that significant technological innovations have had on human history and on today's world.	6	40%	6	40%	3	20%	0	0%
	• Understands critical changes in technology through the different periods of human history.	3	20%	8	53%	4	27%	0	0%
	• Understands how various factors affect technology development.	2	13%	11	73%	2	13%	0	0%
	• Understands the impacts of technology on society and on social institutions such as the family and the political system.	7	47%	7	47%	1	7%	0	0%
	• Understands ways to decrease the negative environmental impact of technological systems and processes and knows how to evaluate trade-offs with respect to different approaches.	7	47%	8	53%	0	0%	0	0%
	• Understands the relationships between engineering, mathematics, science, and technology.	9	60%	6	40%	0	0%	0	0%

Table 4 (continued)

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
II.	**Technological Design and Problem Solving**	**13**	**87%**	**2**	**13%**	**0**	**0%**	**0**	**0%**
	• Understands how to implement and document the steps of a design process.	12	80%	3	20%	0	0%	0	0%
	• Knows how to select and use tools—especially software—in a design process, including the creation, testing, evaluation, and communication of solutions.	7	47%	8	53%	0	0%	0	0%
	• Understands how to identify a problem and define design requirements (criteria and constraints).	10	67%	5	33%	0	0%	0	0%
	• Knows how to generate possible solutions to design problems and how to select, develop, and refine design proposals, using analysis and creativity.	10	67%	5	33%	0	0%	0	0%
	• Knows how to evaluate, test, and optimize designs, using specifications, design principles, modeling, experimentation, and prototyping.	8	53%	7	47%	0	0%	0	0%
	• Understands how to organize and communicate the solution to a design problem.	6	40%	9	60%	0	0%	0	0%
	• Understands systems thinking and knows how to model it for students.	12	80%	3	20%	0	0%	0	0%
	• Understands there is no such thing as a perfect design and that making design decisions involves balancing trade-offs.	10	67%	5	33%	0	0%	0	0%
	• Knows how to operate, maintain, and troubleshoot technological systems.	6	40%	7	47%	2	13%	0	0%
	• Knows how to apply the design process to systems and problems in energy, power, and transportation.	8	53%	6	40%	1	7%	0	0%

Table 4

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
	• Knows how to apply the design process to problems in information technology and communications technology.	7	47%	6	40%	2	13%	0	0%
	• Knows how to apply the design process to problems in manufacturing and construction.	7	47%	6	40%	2	13%	0	0%
III.	**Energy, Power, and Transportation**	**3**	**20%**	**12**	**80%**	**0**	**0%**	**0**	**0%**
	• Understands and knows how to utilize various types of control.	1	7%	9	60%	5	33%	0	0%
	• Knows how to apply mathematical and scientific principles to solve problems involving the harness, transfer, loss, transmission, and conversion of power and energy.	7	47%	6	40%	2	13%	0	0%
	• Understands energy utilization systems.	1	7%	10	67%	4	27%	0	0%
	• Knows the inputs used in transportation systems.	2	13%	10	67%	3	20%	0	0%
	• Understands the components of vehicles and support systems, including infrastructures and subsystems for propulsion, suspension, control, and guidance.	1	7%	9	60%	5	33%	0	0%
	• Understands the different processes involved in transportation operations, along with the part each process plays in the efficiency of the overall system.	2	13%	7	47%	6	40%	0	0%
	• Understands the different forms of energy and the differences between them.	8	53%	6	40%	1	7%	0	0%
	• Understands and can model the relationship between energy, power, and work.	5	33%	7	47%	3	20%	0	0%

Table 4

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
	• Knows how energy is measured and controlled.	3	20%	9	60%	3	20%	0	0%
	• Knows how to apply concepts of energy and power to solve problems related to them.	4	27%	9	60%	2	13%	0	0%
	• Knows the different ways power is generated and used, including their differences in efficiency and impact on the environment.	2	13%	9	60%	4	27%	0	0%
	• Knows and applies safety practices related to working with energy and power.	8	53%	5	33%	2	13%	0	0%
IV.	**Information and Communication Technologies**	**4**	**27%**	**9**	**60%**	**2**	**13%**	**0**	**0%**
	• Understands major concepts and terminology related to information systems.	8	53%	5	33%	2	13%	0	0%
	• Given a communications problem or task, can identify and knows how to use appropriate tools and materials, especially software and hardware, to address it.	4	27%	9	60%	2	13%	0	0%
	• Knows how to use operating systems, software applications, communication devices, and networking components in the classroom/laboratory.	5	33%	8	53%	2	13%	0	0%
	• Recognizes the various types of network structures.	0	0%	5	33%	10	67%	0	0%
	• Understands the concepts that make up a communications system.	7	47%	6	40%	2	13%	0	0%
	• Understands concepts and terminology related to audio, video, electronic, data, technical, and graphic communications.	4	27%	10	67%	0	0%	1	7%

Table 4

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
	• Knows how to arrange the elements of a communication message so that the message is effective and aesthetically pleasing.	1	7%	10	67%	4	27%	0	0%
	• Knows the impacts of communication technology and media on society and culture.	6	40%	7	47%	2	13%	0	0%
	• Understands legal and ethical issues regarding the use of communications and information technologies.	7	47%	6	40%	1	7%	1	7%
	• Knows issues and trends in information and communications technologies.	5	33%	4	27%	6	40%	0	0%
V.	**Manufacturing and Construction Technologies**	**4**	**27%**	**10**	**67%**	**1**	**7%**	**0**	**0%**
	• Knows the management functions used in construction and manufacturing.	4	27%	7	47%	4	27%	0	0%
	• Knows how to apply a systems model to manufacturing and construction processes.	10	67%	4	27%	1	7%	0	0%
	• Knows the key concepts associated with the efficiency of production.	2	13%	12	80%	1	7%	0	0%
	• Understands the differences between manufacturing systems.	3	20%	6	40%	6	40%	0	0%
	• Knows the variety and properties of materials used in the manufacture of products and can evaluate the suitability of material to different manufacturing purposes.	3	20%	8	53%	4	27%	0	0%

Table 4

Specification Judgments

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
	• Knows the primary processing methods of converting raw materials into industrial materials or standard stock and the secondary processing methods of converting industrial materials into finished products.	1	7%	10	67%	4	27%	0	0%
	• Understands the key concepts and terminology related to construction.	6	40%	7	47%	2	13%	0	0%
	• Knows the variety and properties of materials used in the construction of structures and can evaluate the suitability of material to different construction purposes.	4	27%	8	53%	3	20%	0	0%
	• Understands the numerous constraints on structural designs, such as building codes, cost, and function.	6	40%	8	53%	1	7%	0	0%
	• Knows the systems and subsystems of buildings and structures and the functions they perform.	6	40%	5	33%	4	27%	0	0%
	• Understands static and dynamic loads and how they produce forces that affect stability and failure in a structure.	6	40%	7	47%	2	13%	0	0%
	• Understands the variety of processes used in construction, including on-site and prefabricated techniques.	4	27%	7	47%	4	27%	0	0%
VI.	**Pedagogical and Professional Studies**	**11**	**73%**	**4**	**27%**	**0**	**0%**	**0**	**0%**
	• For a technology education program, knows how to create and implement a curriculum based on state and national standards.	10	67%	4	27%	1	7%	0	0%

Table 4

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
• Knows how to select appropriate instructional content and develop learning activities.	12	80%	3	20%	0	0%	0	0%
• Knows how to choose, adapt, and implement instructional strategies appropriate to both the content and the level at which the content is being taught.	11	73%	4	27%	0	0%	0	0%
• Understands the importance of designing and implementing instructional activities that emphasize problem solving.	14	93%	1	7%	0	0%	0	0%
• Knows how to apply appropriate instructional technology equipment, materials, processes, and tools to enhance teaching and to actively engage students in learning.	7	47%	8	53%	0	0%	0	0%
• Knows how to select and use a variety of assessment methods to monitor and evaluate both student learning and instructional effectiveness.	10	67%	5	33%	0	0%	0	0%
• Knows how to create and maintain a safe and healthy learning environment.	13	87%	2	13%	0	0%	0	0%
• Is aware of the relationship between classroom learning and student organizations.	2	13%	10	67%	3	20%	0	0%
• Understands the relationship between technology education programs and advisory committees.	1	7%	8	53%	6	40%	0	0%
• Knows how to modify instructional activities and methods to address students' diverse needs.	11	73%	4	27%	0	0%	0	0%
• Understands the importance of promoting technology education internally and externally.	7	47%	5	33%	3	20%	0	0%

Table 4

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
• Understands the importance of becoming involved in professional associations and organizations related to technology education.	5	33%	6	40%	4	27%	0	0%
• Understands the importance of the professional growth of the technology education teacher via formal instruction, in-service activities, and professional association meetings.	8	53%	5	33%	2	13%	0	0%
• Is familiar with current educational policy, legislation, and funding opportunities.	8	53%	5	33%	2	13%	0	0%
• Is familiar with opportunities for further education and careers.	5	33%	7	47%	3	20%	0	0%
• Is aware of the history, issues, and trends related to technology education.	4	27%	7	47%	4	27%	0	0%
• Is familiar with the management of resources, records, and budgets.	5	33%	7	47%	3	20%	0	0%
• Recognizes the importance of collaborating with other school faculty to design instruction that integrates knowledge and skills from other core academic subject areas into instruction in technology.	12	80%	3	20%	0	0%	0	0%

Table 5

Final Evaluation

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
• I understood the purpose of this study.	15	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	15	100%	0	0%	0	0%	0	0%
• The opportunity to "take the test" and to discuss the test content was useful	13	87%	2	13%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful	10	67%	5	33%	0	0%	0	0%
• The training for the standard setting judgments was adequate to give me the information I needed to complete my assignment	11	73%	4	27%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	11	73%	4	27%	0	0%	0	0%

Appendix B

Listening. Learning. Leading.

Multi-State Standard Setting Technical Report

PRAXIS TECHNOLOGY EDUCATION (0051)

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

October 2010

Executive Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

Participating States

Panelists from 18 states were recommended by state departments of education to participate on expert panels. The state departments of education recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

Recommended Cut Scores

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers. Panelists were recommended by state departments of education[1] to participate on the two expert panels. The state departments of education recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The two, non-overlapping panels (a) allow each participating state to be represented and (b) provide a replication of the judgment process to strengthen the technical quality of the recommended passing score. For the Praxis Technology Education (0051) assessment, 18 states were represented by 34 panelists across the two panels, (See Appendix A for the names and affiliations of the panelists.)

Table 1

Participating States (and number of panelists) for Multi-State Panels

Arkansas (1 panelist)	New Jersey (2 panelist)
Connecticut (1 panelist)	Nevada (1 panelist)
Idaho (2 panelists)	North Carolina (3 panelists)
Indiana (2 panelists)	Ohio (2 panelists)
Kansas (2 panelists)	Pennsylvania (2 panelists)
Kentucky (3 panelists)	South Carolina (1 panelist)
Louisiana (3 panelists)	Utah (2 panelists)
Maryland (3 panelists)	Wisconsin (2 panelists)
Maine (1 panelist)	Wyoming (1 panelist)

Note. Arkansas, Connecticut, Maine, Nevada, Ohio, South Carolina, Utah and Wyoming were represented on only one of the two panels.

[1] State departments of education that currently use one or more Praxis tests were invited to participate in the multi-state standard setting study.

The panels were convened in September 2010 in Princeton, New Jersey. For both panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing score, or cut score. The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting studies.

The passing score recommendation for the assessment is provided to each of the represented state departments of education. In each state, the department of education, the state board of education, or a designated educator licensure board is responsible for establishing the final passing score in accordance with applicable state regulations.

The first national administration of the new Praxis Technology Education (0051) assessment will occur in fall 2011.

Overview of the Praxis Assessment

The Praxis Technology Education *Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction Technologies* (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions)[2].

Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a

[2] The number of questions for each content area may vary slightly from form to form of the assessment.

candidate's score[3]. The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education (0051) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

For both expert panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing score, or cut score. The following section describes the processes and methods used. (The agenda for the panel meetings is presented in Appendix A.)

The design of the standard setting study included two non-overlapping expert panels. The training provided to panelists as well as the study materials were consistent across panels with the exception of defining the Just Qualified Candidate (JQC). To assure that both panels were using the same frame of reference when making question-level standard setting judgments, the JQC definition developed through a consensus process by the first panel was used as the definition for the second panel. The second panel did complete a thorough review of the definition to allow panelists to internalize the definition. The processes for developing the definition (with Panel 1) and reviewing/internalizing the definition (with Panel 2) are described later, and the Just Qualified Candidate definition is presented in Appendix C.

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by the meeting facilitator, Dr. Wanda Swiggett from the Center for Validity Research. She explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

[3] Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate's score.

Reviewing the Assessment

The first activity was for the panelists to "take the test." (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the 120 multiple-choice questions. (Panelists were instructed not to refer to the answer key while taking the test.) The purpose of "taking the test" was for the panelists to become familiar with the test format, content, and difficulty. After "taking the test," the panelists checked their responses against the answer key.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering technology education teachers, and areas that addressed content that would be particularly important for entering teachers.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified technology education teacher. The JQC definition is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

In Panel 1, the panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to the Praxis Technology Education *Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a definition (see Appendix C).

In Panel 2, the panelists began with the definition of the JQC developed by the first panel. Given that the multi-state standard setting study was designed to replicate processes and procedures across the two panels, it was important that both panels use consistent JQC definitions to frame their judgments. For Panel 2, the panelists reviewed the JQC definition, and any ambiguities were discussed and clarified. The panelists then were split into smaller groups, and each group developed performance indicators or "can do" statements based on the definition. The purpose of the indicators was to provide clear examples of what might be observed to indicate that the teacher had the defined knowledge. The performance indicators were shared across the group, and discussed and added to the definition. The panel also had

an opportunity to suggest minor changes to the initial definition, if doing so added clarity. No significant changes to the initial definition were suggested by Panel 2.

Panelists' Judgments

A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used for the multiple-choice questions. In this approach, for each question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

For each panel, the panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- easy questions for a JQC were in the .70 to 1 range; and
- moderately difficult/easy questions for a JQC were in the .40 to .60 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on the first five questions.

The panelists engaged in two rounds of judgments. Following Round 1, feedback was provided to the panel, including each panelist's (listed by ID number) recommended cut scores and the panel's average recommended cut score, highest and lowest cut scores, and standard deviation. Following discussion, the panelists' judgments were displayed for each question. The panelists' judgments were summarized by the three general difficulty levels (0 to .30, .40 to .60, and .70 to 1), and the panel's average question judgment was provided. Questions were highlighted to show when panelists converged

in their judgments (at least two-thirds of the panelists located a question in the same difficulty range) or diverged in their judgments. Panelists were asked to share their rationales for the judgments they made. Following this discussion, panelists were provided an opportunity to change their question-level standard-setting judgments (Round 2).

Other than the definition of the JQC, results from Panel 1 were not shared with the second panel. The question-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

Judgment of Content Specifications

In addition to the two-round standard setting process, each panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level technology education teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — V*ery Important*, I*mportant*, S*lightly Important*, and N*ot Important*. Each panelist independently judged the six knowledge categories and 73 knowledge/skills statements.

Results

Results are presented separately for the two panels. The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score.

Expert Panels

The standard setting study included two expert panels. The various state departments of education recruited panelists to represent a range of professional perspectives. A description of the panels is presented below. (See Appendix A for a listing of panelists for each panel.)

Panel 1 included 18 teachers, administrators, and college faculty who prepare technology education teachers, representing 14 states. In brief, 12 panelists were teachers, two were administrators or department heads, and four were college faculty. All four of the panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Fifteen panelists were White, one was African American, and one was Asian American. Six panelists were female.

Sixteen panelists reported being certified technology education teachers in their states. Two-thirds of panelists (12 of the 18 panelists or 67%) had seven or fewer years of experience as a technology education teacher, and two had 16 or more years of teaching experience.

Panel 2 included 16 teachers, administrators, and college faculty, representing 14 states. In brief, six panelists were teachers, four were administrators or department heads, five were college faculty, and one was a technology integration specialist. Four of the five panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Thirteen panelists were White, two were African American, and one was Asian American. Six panelists were female. Eleven panelists reported being certified technology education teachers in their states. Over half of panelists (9 of the 16 panelists or 56%) had seven or fewer years of experience as a technology education teacher, and three had 16 or more years of teaching experience.

A fuller demographic description for the members of the two panels is presented in Tables D1 and D2 in Appendix D.

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. Across both panels, all panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments by Round.

A summary of each round of standard-setting judgments is presented in Appendix D. The numbers in each table reflect the recommended cut scores — the number of raw points needed to "pass" the assessment — of each panelist for the two rounds. The panel's average recommended cut score and highest and lowest cut scores are reported, as are the standard deviations (SD) of panelists' cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panels to recommend the same cut score on the same form of the assessment. A comparable panel's cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists' judgments — was observed for both panels. The Round 2 average total score is the panel's recommended cut score (passing score).

The panels' cut score recommendations for the Praxis Technology Education (0051) assessment are 71.86 for Panel 1 and 73.92 for Panel 2 (see Tables D3 and D4 in Appendix D). The values were rounded to the next highest whole number to determine the functional recommended cut scores — 72 for Panel 1 and 74 for Panel 2. The values of 72 and 74 represent approximately 65% and 67%, respectively, of the total available 110 raw-score points that could be earned on the assessment. The scaled scores associated with 72 and 74 raw points are 158 and 160, respectively.[4]

Table D5 (in Appendix D) present the estimated standard errors of measurement (SEM) around the recommended cut scores for each panel. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard errors provided are an estimate, given that the Praxis Technology Education (0051) assessment has not yet been administered.

In addition to the recommended cut scores for each panel, the average cut across the two panels is provided to help state departments of education determine an appropriate cut (or passing) score for the Praxis Technology Education (0051) assessment. The panels' average cut score recommendation for the Praxis Technology Education (0051) assessment is 72.89. The value was rounded to 73 (next highest raw score) to determine the functional recommended cut score. The value of 73 represents approximately 66% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 73 raw points is 159. Table D5 (in Appendix D) presents the standard error of measurement (SEM) around the recommended cut score combining the information from the two panels.

[4] For reference purposes, if the recommended raw cut score was 71 or 73 points, the scaled score would be 156 or 159, respectively.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Technology Education (0051) assessment content specifications were important for entry-level technology education teachers. Panelists rated the six knowledge categories and 73 knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Table D6 (in Appendix D).

The six knowledge categories were judged to be *Very Important* or *Important* by 85% or more of the panelists. The knowledge categories of *Pedagogical and Professional Studies* (85% of the panelists judged as *Very Important*) and *Technological Design and Problem Solving* (79% of the panelists judged as *Very Important*) were seen as the most important for beginning technology education teachers. The knowledge categories of *Information and Communication Technologies* (15% of the panelists judged as *Slightly Important*) and *Manufacturing and Construction Technologies* (12% of the panelists judged as *Slightly Important*) were seen as less important for beginning technology education teachers. All but nine of the 73 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations.

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. Tables D7 and D8 (in Appendix D) present the results of the final evaluations.

All panelists *agreed* or *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Across the two panels, all but one of the panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow. All but one of the panelists reported that the definition of the JQC was at least *somewhat influential* in guiding their standard-setting judgments. All but one of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Across the two panels, 10 of the 34 panelist indicated that the cut scores of other panelists did not influence their judgments.

There were similar ratings between the two panels when asked to respond to their level of comfort with their panel's recommended passing score. All but three of the 34 panelists indicated they were *very* or *somewhat comfortable* with their recommendation. Two panelists (one from each panel) reported being *somewhat uncomfortable* with their recommended passing score; one panelist from Panel 1 reported being *very uncomfortable* with the panel's recommended passing score. For both panels, the majority of the panelists indicated that the recommend cut score was *about right* (100% for Panel 1 and 88% for Panel 2) and the remaining panelists from Panel 2 indicated the cut score was *too low*.

Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

References

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Appendix A

Panelists' Names & Affiliations

Praxis Technology Education

Panel 1[5]

Panelist	Affiliation
Akers, Ruth	Baltimore County Public Schools (MD)
Bishopp, Doug	Tripp Middle School (ME)
Christensen, Brad	Berea College (KY)
Doring, Susan A.	Paul Laurence Dunbar (KY)
Gilliam, Deborah	Grambling State University (LA)
Huffman, Tanner	Richland School District (PA)
Johnson, Jason	Mukwonago Area School District (WI)
Kelley, Todd	Purdue (IN)
Kerr, Janel	University of Idaho (ID)
Levy, Donna	Clark County School District (NV)
McCoy, Benjamin Mabe	London High School (OH)
Neden, Michael	Pittsburg State University (KS)
Sansuchat, Dan	Granville Middle School (OH)
Semko, Thomas	New Jersey Technology Education Association (NJ)
Smoot, Michael	Jordan Applied Technology Center (UT)
Sonnier, Wendy	Welsh High School (LA)
Wykoff, Matthew V.	Vance High School (NC)

Panel 2

Panelist	Affiliation
Brusic, Sharon	Millersville University (PA)
Butler, John M.	Dalton L. McMichael High School (NC)
Cattanach, Bruce	The Lakeview School (NJ)
Day, Gerald	University of Maryland Eastern Shore (MD)
Dischino, Michele	Central Connecticut State University (CT)
Gensemer, Amy	Montgomery County Public Schools (MD)
Hung, Jui-Long	Boise State University (ID)
Kalk, Rick	Spartanburg School District Five (SC)
Kaluf, Kevin	Kankakee Valley High School (IN)
Raper, Johnna Shantele	Osceola School District and Arkansas Northeastern College (AR)
Rigler, Kenny	Fort Hays State University (KS)
Roubion, Eric M.	Orleans Parish School Board (LA)
Scott, Kwamina	Kernersville Middle (NC)
Shotts, Alan	Cody High School (WY)
Ubersox, Ryan J.	Waunakee Community High School (WI)
Waggoner, Erin	Jessamine County Schools (KY)

[5] One panelist on Panel 1 declined to have his/her name listed in the technical report.

Appendix B

Workshop Agenda

Praxis Technology Education Assessment

Standard Setting Study

Day 1

9:00 – 9:15	**Welcome and Introductions**
9:15 – 9:45	**Overview of Standard Setting & Workshop Events**
9:45 – 9:55	**Overview of the Praxis Technology Education Assessment**
9:55 – 10:00	**Break**
10:00 – 11:30	**"Take" the Praxis Technology Education Assessment**
11:30 – 12:00	**Discuss the Praxis Technology Education Assessment**
12:00 – 12:45	**Lunch**
12:45 – 3:00	**Define the Knowledge/Skills of a JQC**
3:00 – 3:05	**Break**
3:05 – 3:30	**Standard Setting Training**
3:30 – 5:00	**Round 1 Standard Setting Judgments for Questions 1-80**
5:00 – 5:15	**Collect Materials; End of Day 1**

Praxis Technology Education Assessment

Standard Setting Study

Day 2

9:00 – 9:15	**Overview of Day 2**
9:15 – 9:30	**Review of the Standard Setting Process**
9:30 – 10:30	**Round 1 Standard Setting Judgments for Questions 81-120**
10:30 – 10:45	**Break**
10:45 – 12:00	**Round 1 Feedback & Round 2 Judgments**
12:00 – 1:00	**Lunch**
1:00 – 2:30	**Round 1 Feedback & Round 2 Judgments (continued)**
2:30 – 2:45	**Break**
2:45 – 3:15	**Specification Judgments**
3:15 – 3:30	**Feedback on Round 2 Recommended Cut Score**
3:30 – 3:45	**Complete Final Evaluation**
3:45 – 4:00	**Collect Materials; End of Study**

Appendix C

Just Qualified Candidate (JQC) Definitions

Description of a Just Qualified Candidate
Praxis Technology Education

A JQC …

- Understands the importance of collaboration and interdisciplinary teaching and demonstrates the relationships in context between technology and other curricular areas
- Understands major concepts, terminology, and uses appropriate tools related to information/communication systems
- Can identify and model key safety concerns and practices
- Can describe and apply the steps of an engineering design process
- Can identify objectives that best address specific national standards
- Understands the basic technology core topics, i.e., power, energy, transportation, manufacturing, communication, information technology, construction
- Understands and applies the systems model
- Understands and utilizes a variety of professional development opportunities and professional and student organization
- Can evaluate a technology and identify its interrelationships with society
- Utilizes multiple instructional strategies and assessments that facilitate student achievement in technology literacy

Appendix D

Results for Praxis Technology Education

Table D1

Panel Member Demographics — Panel 1

	N	Percent
Current Position		
Teachers	12	67%
Teacher/Administrator	2	11%
College Faculty	4	22%
Race		
White	15	83%
Black or African American	1	6%
Asian or Asian American	1	6%
Other	1	6%
Gender		
Female	6	33%
Male	12	67%
Are you currently certified as a Technology Education teacher in your state?		
Yes	16	89%
No	2	11%
Are you currently teaching Technology Education in your state?		
Yes	14	78%
No	4	22%
Are you currently supervising or mentoring other Technology Education teachers?		
Yes	11	61%
No	7	39%
How many years of experience do you have teaching Technology Education?		
3 years or less	3	17%
4 - 7 years	9	50%
8 - 11 years	2	11%
12 - 15 years	2	11%
16 years or more	2	11%

Table D1 (continued)

Panel Member Demographics — Panel 1

	N	Percent
At what K-12 grade level are you currently teaching Technology Education?		
Elementary (K - 5 or K - 6)	1	6%
Middle School (6 - 8 or 7 - 9)	3	17%
High School (9 - 12 or 10 - 12)	7	39%
Middle and High School	1	6%
Other	1	6%
Not currently teaching at the K-12 level	5	28%
Which best describes the location of your K-12 school?		
Urban	5	28%
Suburban	3	17%
Rural	6	33%
Not currently working in a K-12 school	4	22%
If you are college faculty, are you currently involved in the training/preparation of Technology Education teachers?		
Yes	4	22%
No	0	0%
Not college faculty	14	78%

Table D2

Panel Member Demographics — Panel 2

	N	Percent
Current Position		
Teachers	6	38%
Administrator/Department Head	4	25%
College Faculty	5	31%
Technology Integration Specialist	1	6%
Race		
White	13	81%
Black or African American	2	13%
Asian or Asian American	1	6%
Gender		
Female	6	38%
Male	10	63%
Are you currently certified as a Technology Education teacher in your state?		
Yes	11	69%
No	5	31%
Are you currently teaching Technology Education in your state?		
Yes	10	63%
No	6	38%
Are you currently supervising or mentoring other Technology Education teachers?		
Yes	10	63%
No	6	38%
How many years of experience do you have teaching Technology Education?		
3 years or less	2	13%
4 - 7 years	7	44%
8 - 11 years	3	19%
12 - 15 years	1	6%
16 years or more	3	19%

Table D2 (continued)

Panel Member Demographics — Panel 2

	N	Percent
At what K-12 grade level are you currently teaching Technology Education?		
Elementary (K - 5 or K - 6)		
Middle School (6 - 8 or 7 - 9)	2	13%
High School (9 - 12 or 10 - 12)	3	19%
Middle and High School	1	6%
Other	2	13%
Not currently teaching at the K-12 level	8	50%
Which best describes the location of your K-12 school?		
Urban	1	6%
Suburban	4	25%
Rural	6	38%
Not currently working in a K-12 school	5	31%
If you are college faculty, are you currently involved in the training/preparation of Technology Education teachers?		
Yes	4	25%
No	1	6%
Not college faculty	11	69%

Table D3

Cut score Summary by Round of Judgments — Panel 1

Panelist	Round 1	Round 2
1	81.85	79.25
2	70.40	69.95
3	73.00	72.60
4	71.55	72.05
5	84.90	84.05
6	76.05	76.55
7	77.85	77.60
8	55.40	56.35
9	70.65	71.80
10	60.30	60.70
11	80.40	74.80
12	69.90	71.00
13	61.85	64.45
14	78.50	75.10
15	77.35	76.85
16	72.20	71.90
17	47.20	58.10
18	82.45	80.40
Average	71.77	71.86
SD	10.01	7.63
SEJ	2.36	1.80
Highest	84.90	84.05
Lowest	47.20	56.35

Table D4

Cut score Summary by Round of Judgments — Panel 2

Panelist	Round 1	Round 2
1	69.35	70.15
2	75.00	74.50
3	61.50	62.10
4	77.20	77.05
5	78.20	77.80
6	74.05	82.30
7	76.40	78.00
8	57.80	60.30
9	84.60	83.65
10	70.65	73.65
11	77.45	78.40
12	84.85	84.95
13	64.85	69.55
14	58.05	62.55
15	91.00	89.25
16	58.15	58.45
Average	72.44	73.92
SD	10.22	9.35
SEJ	2.56	2.34
Highest	91.00	89.25
Lowest	57.80	58.45

Table D5

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score

(a) Panel 1

Recommended Cut Score (SEM)		Scale Score Equivalent
72 (5.01)		158
- 2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+ 2 SEMs	83	172

(b) Panel 2

Recommended Cut Score (SEM)		Scale Score Equivalent
74 (4.94)		160
- 2 SEMs	65	149
-1 SEM	70	155
+1 SEM	79	167
+ 2 SEMs	84	173

(c) Combined Across Panels

Recommended Cut Score (SEM)		Scale Score Equivalent
73 (4.98)		159
- 2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+ 2 SEMs	83	172

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Table D6

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
I.	**Technology and Society**	**12**	**35%**	**21**	**62%**	**1**	**3%**	**0**	**0%**
	• Understands the nature of technology, technology education, and technological literacy.	23	68%	10	29%	1	3%	0	0%
	• Understands how invention and innovation occur, how they are influenced by cultural and economic factors, and how they are built on existing technologies.	13	38%	21	62%	0	0%	0	0%
	• Understands how technological development is influenced by knowledge from other fields of study, especially mathematics and the sciences.	20	59%	14	41%	0	0%	0	0%
	• Understands the influence that significant technological innovations have had on human history and on today's world.	8	24%	17	50%	9	26%	0	0%
	• Understands critical changes in technology through the different periods of human history.	5	15%	23	68%	6	18%	0	0%
	• Understands how various factors affect technology development.	7	21%	23	68%	4	12%	0	0%
	• Understands the impacts of technology on society and on social institutions such as the family and the political system.	16	47%	14	41%	4	12%	0	0%
	• Understands ways to decrease the negative environmental impact of technological systems and processes and knows how to evaluate trade-offs with respect to different approaches.	13	38%	19	56%	2	6%	0	0%
	• Understands the relationships between engineering, mathematics, science, and technology.	26	76%	8	24%	0	0%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
II.	**Technological Design and Problem Solving**	**27**	**79%**	**7**	**21%**	**0**	**0%**	**0**	**0%**
	• Understands how to implement and document the steps of a design process.	29	85%	5	15%	0	0%	0	0%
	• Knows how to select and use tools—especially software—in a design process, including the creation, testing, evaluation, and communication of solutions.	17	50%	16	47%	1	3%	0	0%
	• Understands how to identify a problem and define design requirements (criteria and constraints).	23	68%	9	26%	2	6%	0	0%
	• Knows how to generate possible solutions to design problems and how to select, develop, and refine design proposals, using analysis and creativity.	20	59%	14	41%	0	0%	0	0%
	• Knows how to evaluate, test, and optimize designs, using specifications, design principles, modeling, experimentation, and prototyping.	20	59%	12	35%	2	6%	0	0%
	• Understands how to organize and communicate the solution to a design problem.	20	59%	13	38%	1	3%	0	0%
	• Understands systems thinking and knows how to model it for students.	19	56%	13	38%	2	6%	0	0%
	• Understands there is no such thing as a perfect design and that making design decisions involves balancing trade-offs.	13	38%	20	59%	1	3%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
	• Knows how to operate, maintain, and troubleshoot technological systems.	12	35%	18	53%	4	12%	0	0%
	• Knows how to apply the design process to systems and problems in energy, power, and transportation.	14	41%	20	59%	0	0%	0	0%
	• Knows how to apply the design process to problems in information technology and communications technology.	15	44%	16	47%	3	9%	0	0%
	• Knows how to apply the design process to problems in manufacturing and construction.	16	47%	15	44%	3	9%	0	0%
III.	**Energy, Power, and Transportation**	**8**	**24%**	**23**	**68%**	**3**	**9%**	**0**	**0%**
	• Understands and knows how to utilize various types of control.	9	26%	21	62%	4	12%	0	0%
	• Knows how to apply mathematical and scientific principles to solve problems involving the harness, transfer, loss, transmission, and conversion of power and energy.	11	32%	22	65%	1	3%	0	0%
	• Understands energy utilization systems.	6	18%	20	59%	8	24%	0	0%
	• Knows the inputs used in transportation systems.	4	12%	18	53%	12	35%	0	0%
	• Understands the components of vehicles and support systems, including infrastructures and subsystems for propulsion, suspension, control, and guidance.	4	12%	18	53%	12	35%	0	0%
	• Understands the different processes involved in transportation operations, along with the part each process plays in the efficiency of the overall system.	2	6%	19	56%	13	38%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
	• Understands the different forms of energy and the differences between them.	20	59%	14	41%	0	0%	0	0%
	• Understands and can model the relationship between energy, power, and work.	11	32%	18	53%	5	15%	0	0%
	• Knows how energy is measured and controlled.	9	26%	19	56%	6	18%	0	0%
	• Knows how to apply concepts of energy and power to solve problems related to them.	12	35%	21	62%	1	3%	0	0%
	• Knows the different ways power is generated and used, including their differences in efficiency and impact on the environment.	11	32%	20	59%	3	9%	0	0%
	• Knows and applies safety practices related to working with energy and power.	28	82%	5	15%	1	3%	0	0%
IV.	**Information and Communication Technologies**	**12**	**35%**	**17**	**50%**	**5**	**15%**	**0**	**0%**
	• Understands major concepts and terminology related to information systems.	19	56%	11	32%	4	12%	0	0%
	• Given a communications problem or task, can identify and knows how to use appropriate tools and materials, especially software and hardware, to address it.	14	41%	18	53%	2	6%	0	0%
	• Knows how to use operating systems, software applications, communication devices, and networking components in the classroom/laboratory.	12	35%	16	47%	6	18%	0	0%
	• Recognizes the various types of network structures.	2	6%	8	24%	21	62%	3	9%
	• Understands the concepts that make up a communications system.	8	24%	20	59%	6	18%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
	• Understands concepts and terminology related to audio, video, electronic, data, technical, and graphic communications.	2	6%	25	74%	7	21%	0	0%
	• Knows how to arrange the elements of a communication message so that the message is effective and aesthetically pleasing.	7	21%	18	53%	9	26%	0	0%
	• Knows the impacts of communication technology and media on society and culture.	7	21%	19	56%	7	21%	1	3%
	• Understands legal and ethical issues regarding the use of communications and information technologies.	21	62%	10	29%	3	9%	0	0%
	• Knows issues and trends in information and communications technologies.	6	18%	23	68%	5	15%	0	0%
V.	**Manufacturing and Construction Technologies**	**7**	**21%**	**23**	**68%**	**4**	**12%**	**0**	**0%**
	• Knows the management functions used in construction and manufacturing.	7	21%	20	59%	7	21%	0	0%
	• Knows how to apply a systems model to manufacturing and construction processes.	18	53%	13	38%	3	9%	0	0%
	• Knows the key concepts associated with the efficiency of production.	9	26%	18	53%	7	21%	0	0%
	• Understands the differences between manufacturing systems.	4	12%	19	56%	11	32%	0	0%
	• Knows the variety and properties of materials used in the manufacture of products and can evaluate the suitability of material to different manufacturing purposes.	7	21%	21	62%	6	18%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

		Very Important		Important		Slightly Important		Not Important	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
	• Knows the primary processing methods of converting raw materials into industrial materials or standard stock and the secondary processing methods of converting industrial materials into finished products.	8	24%	18	53%	8	24%	0	0%
	• Understands the key concepts and terminology related to construction.	16	47%	12	35%	6	18%	0	0%
	• Knows the variety and properties of materials used in the construction of structures and can evaluate the suitability of material to different construction purposes.	9	26%	19	56%	6	18%	0	0%
	• Understands the numerous constraints on structural designs, such as building codes, cost, and function.	8	24%	15	44%	10	29%	1	3%
	• Knows the systems and subsystems of buildings and structures and the functions they perform.	3	9%	20	59%	10	29%	1	3%
	• Understands static and dynamic loads and how they produce forces that affect stability and failure in a structure.	11	32%	14	41%	9	26%	0	0%
	• Understands the variety of processes used in construction, including on-site and prefabricated techniques.	4	12%	16	47%	14	41%	0	0%
VI.	**Pedagogical and Professional Studies**	**29**	**85%**	**5**	**15%**	**0**	**0%**	**0**	**0%**
	• For a technology education program, knows how to create and implement a curriculum based on state and national standards.	25	74%	8	24%	1	3%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to select appropriate instructional content and develop learning activities.	29	85%	5	15%	0	0%	0	0%
• Knows how to choose, adapt, and implement instructional strategies appropriate to both the content and the level at which the content is being taught.	27	79%	7	21%	0	0%	0	0%
• Understands the importance of designing and implementing instructional activities that emphasize problem solving.	25	74%	9	26%	0	0%	0	0%
• Knows how to apply appropriate instructional technology equipment, materials, processes, and tools to enhance teaching and to actively engage students in learning.	19	56%	14	41%	1	3%	0	0%
• Knows how to select and use a variety of assessment methods to monitor and evaluate both student learning and instructional effectiveness.	20	59%	14	41%	0	0%	0	0%
• Knows how to create and maintain a safe and healthy learning environment.	31	91%	3	9%	0	0%	0	0%
• Is aware of the relationship between classroom learning and student organizations.	5	15%	18	53%	11	32%	0	0%
• Understands the relationship between technology education programs and advisory committees.	6	18%	12	35%	12	35%	4	12%
• Knows how to modify instructional activities and methods to address students' diverse needs.	23	68%	10	29%	1	3%	0	0%
• Understands the importance of promoting technology education internally and externally.	11	32%	16	47%	6	18%	1	3%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
• Understands the importance of becoming involved in professional associations and organizations related to technology education.	5	15%	21	62%	7	21%	1	3%
• Understands the importance of the professional growth of the technology education teacher via formal instruction, in-service activities, and professional association meetings.	10	29%	20	59%	3	9%	1	3%
• Is familiar with current educational policy, legislation, and funding opportunities.	7	21%	12	35%	13	38%	2	6%
• Is familiar with opportunities for further education and careers.	8	24%	11	32%	13	38%	2	6%
• Is aware of the history, issues, and trends related to technology education.	6	18%	16	47%	12	35%	0	0%
• Is familiar with the management of resources, records, and budgets.	10	29%	15	44%	8	24%	1	3%
• Recognizes the importance of collaborating with other school faculty to design instruction that integrates knowledge and skills from other core academic subject areas into instruction in technology.	20	59%	13	38%	1	3%	0	0%

Table D7

Final Evaluation — Panel 1

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
• I understood the purpose of this study.	15	83%	3	17%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	14	78%	4	22%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	13	72%	5	28%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	10	56%	8	44%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	15	83%	2	11%	1	6%	0	0%
• The process of making the standard setting judgments was easy to follow.	10	56%	7	39%	1	6%	0	0%

Table D7 (continued)

Final Evaluation — Panel 1

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential	
	N	Percent	N	Percent	N	Percent
• The definition of the JQC	15	83%	2	11%	1	6%
• The between-round discussions	8	47%	8	47%	1	6%
• The knowledge/skills required to answer each test question	10	56%	8	44%	0	0%
• The cut scores of other panel members	3	18%	10	59%	4	24%
• My own professional experience	16	89%	2	11%	0	0%

	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	11	61%	5	28%	1	6%	1	6%

	Too Low		About Right		Too High	
	N	Percent	N	Percent	N	Percent
• Overall, the recommended cut score is:	0	0%	18	100%	0	0%

Table D8

Final Evaluation — Panel 2

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	15	94%	1	6%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	11	69%	5	31%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	12	75%	4	25%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	13	81%	3	19%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	12	75%	4	25%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	10	63%	6	38%	0	0%	0	0%

Table D8 (continued)

Final Evaluation — Panel 2

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential	
	N	Percent	N	Percent	N	Percent
• The definition of the JQC	13	81%	3	19%	0	0%
• The between-round discussions	6	38%	10	63%	0	0%
• The knowledge/skills required to answer each test question	10	63%	6	38%	0	0%
• The cut scores of other panel members	0	0%	9	60%	6	40%
• My own professional experience	13	81%	3	19%	0	0%

	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	9	56%	6	38%	1	6%	0	0%

	Too Low		About Right		Too High	
	N	Percent	N	Percent	N	Percent
• Overall, the recommended cut score is:	2	13%	14	88%	0	0%